INVADR Data Modulation Parameters

The INVADR system transmits at a data rate of 19200 bits per second (19.2 kbps) over a 25000 Hz (25 kHz) channel. The authorized modulation bandwidth is 20000 Hz (20 kHz). Four level Frequency Shift Key (FSK) modulation is utilized, where each transmitted symbol represents two bits of data. Therefore 9600 symbols per second are transmitted. Each symbol is 1/9600 seconds long. Symbol +3 represents data bits 11, symbol +1 represents data bits 10, symbol –1 represents data bits 00 and symbol –3 represents data bits 01. The highest frequency possible is a square wave consisting of a positive symbol followed by a negative symbol, all other symbol combinations are at a lower frequency. Consider a data stream of 1101. This is transmitted as +3, -3, which is a square wave of period 1/9600+1/9600 seconds. The fundamental frequency of the symbols is 4800 Hz. For a 19.2 kbps INVADR system deviation is set to 5.0 KHz. The reason the INVADR system is able to operate in a 20 kHz bandwidth is the MX919B modem chip's Root Raised Cosine (RRC) filter's 3 dB cutoff frequency is set to be approximately 0.5 of the symbol rate or 4800 Hz. The RRC filter has a very sharp cutoff characteristic and it has 30 dB attenuation at 5760 Hz. At the 3 dB cutoff frequency of approximately 4800 Hz, the over the air signal has an occupied bandwidth of 19600 Hz by Carson's rule.